

Near real-time passive acoustic monitoring of right whales along the U.S. east coast

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Like aerial surveys, near real-time passive acoustic monitoring can be used to understand the distribution and occurrence of right whales and to support dynamic management efforts. The Woods Hole Oceanographic Institution has developed and evaluated an operational near real-time whale detection system for long-endurance ocean gliders and buoys based on the digital acoustic monitoring (DMON) instrument and the low-frequency detection and classification system (LFDCS). Gliders equipped with the DMON/LFDCS have been used to monitor right whales in Canadian waters annually since 2014. The use of gliders and buoys for right whale monitoring has been sporadic on the U.S. east coast to date, but expanded and more regular monitoring is planned for coming years, spurred in large part by wind energy development activities. I will review glider survey effort and buoy deployments from the past year that took place in the Gulf of Maine, New York Bight, and near Cape Hatteras, and will discuss plans to conduct several more glider surveys and to install five more DMON/LFDCS buoys in the coming year along the U.S. east coast.

PAM monitoring in the Gulf of Maine: 2009 vs 2019

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The Gulf of Maine is recognized historically as an important habitat for the North Atlantic right whale (NARW), identified as both feeding and mating grounds. Despite this, very little acoustic monitoring effort has occurred in this area. Passive acoustic monitoring recorders were deployed in 13 locations along the inner coast of Maine during 2009-2010. Most recorders were out for an average of 3 months, some 6 months, during the winter. Recordings were analyzed using an automatic low frequency detection and classification system (LFDCS; Baumgartner & Mussoline 2011) for NARW upcalls and results were included in a long-term acoustic analysis looking at right whale presence along the entire western North Atlantic coastline (Davis et al. 2017). We took a closer look at this data, manually screening all sound files by hand for upcalls and other NARW call types, to further determine when NARWs were present along Maine's coast. Future plans of deploying recorders in the same locations as the 2009-2010 recorders are starting in fall/winter 2019 for a continuous year of coverage. Simultaneously, a real-time glider will survey along the Gulf of Maine from December 2019-April 2020 and another glider in Stellwagen Bank National Marine Sanctuary from January- April 2020, furthering acoustic coverage offshore and extending into waters off Massachusetts. These recorders will all undergo similar, fine-scale analyses to gain a better understanding of NARWs' use of inshore Maine waters and how this might compare to previous NARW distributions.

Passive Acoustic Monitoring (PAM): Previous and upcoming work off the U.S. east coast

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Erin Summers⁴, Jennifer Turek¹, Sofie Van Parijs¹



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²University of Massachusetts Boston

³Woods Hole Oceanographic Institution
⁴Maine Department of Marine Resources



PASSIVE ACOUSTIC MONITORING (PAM)

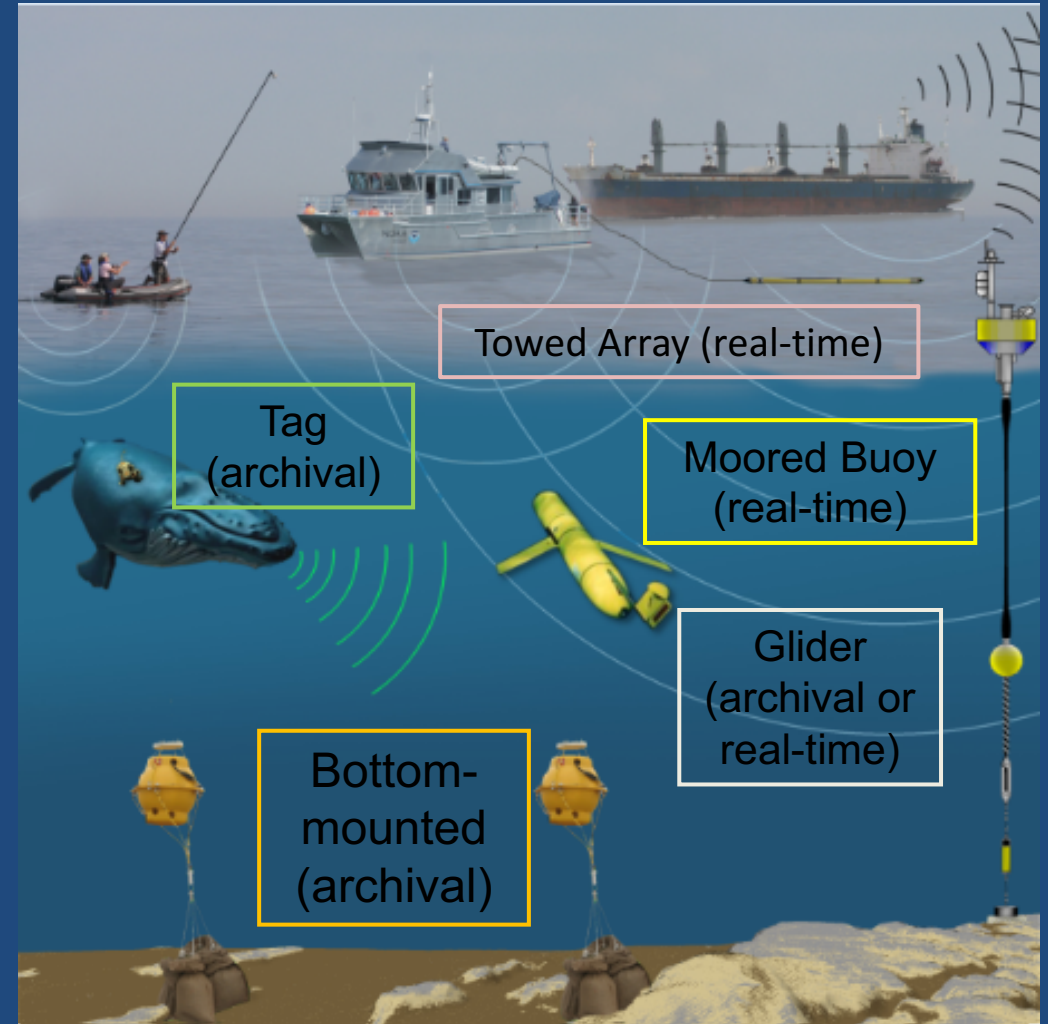
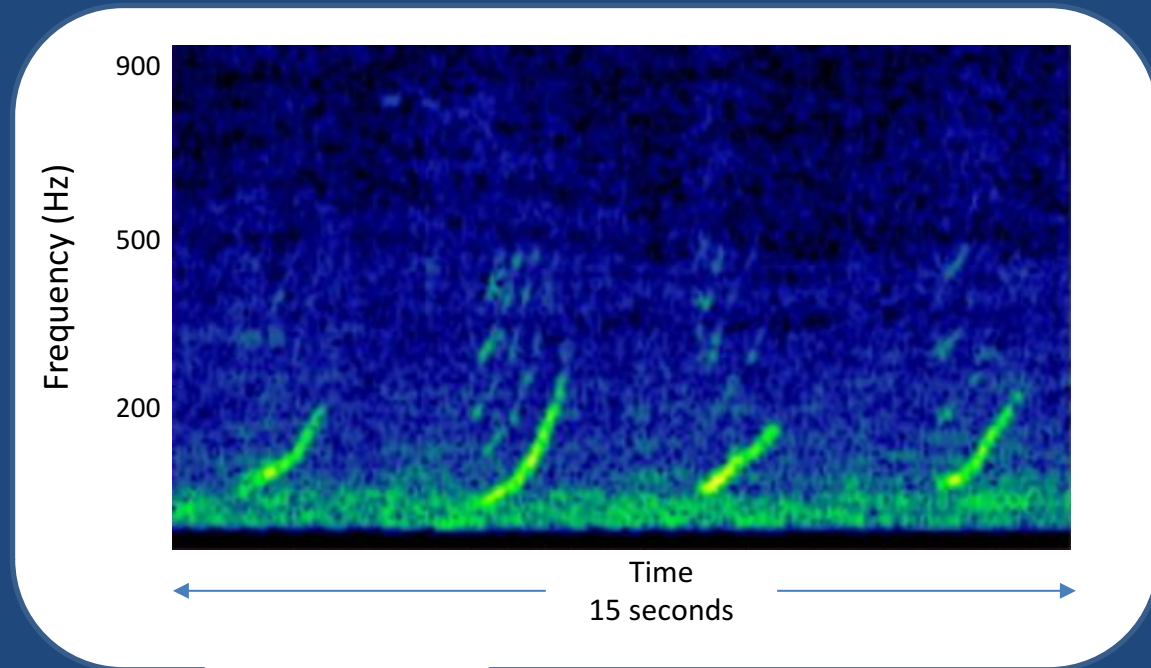
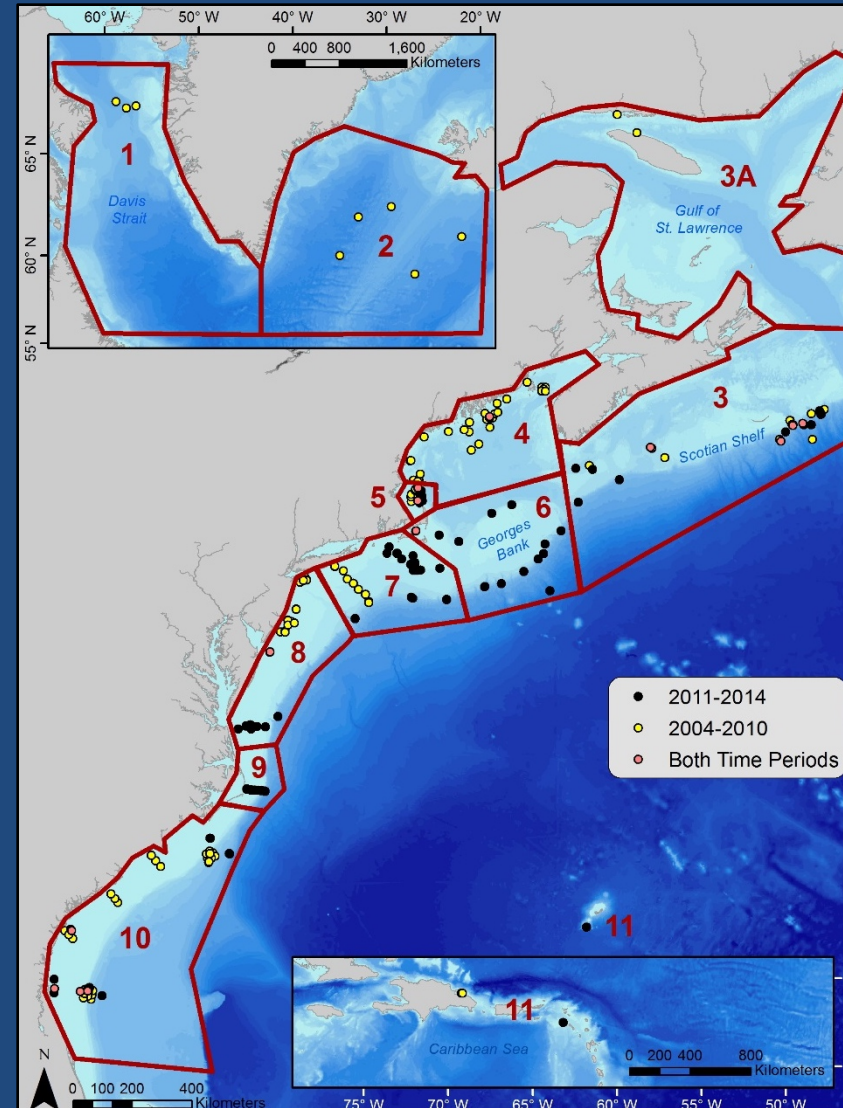
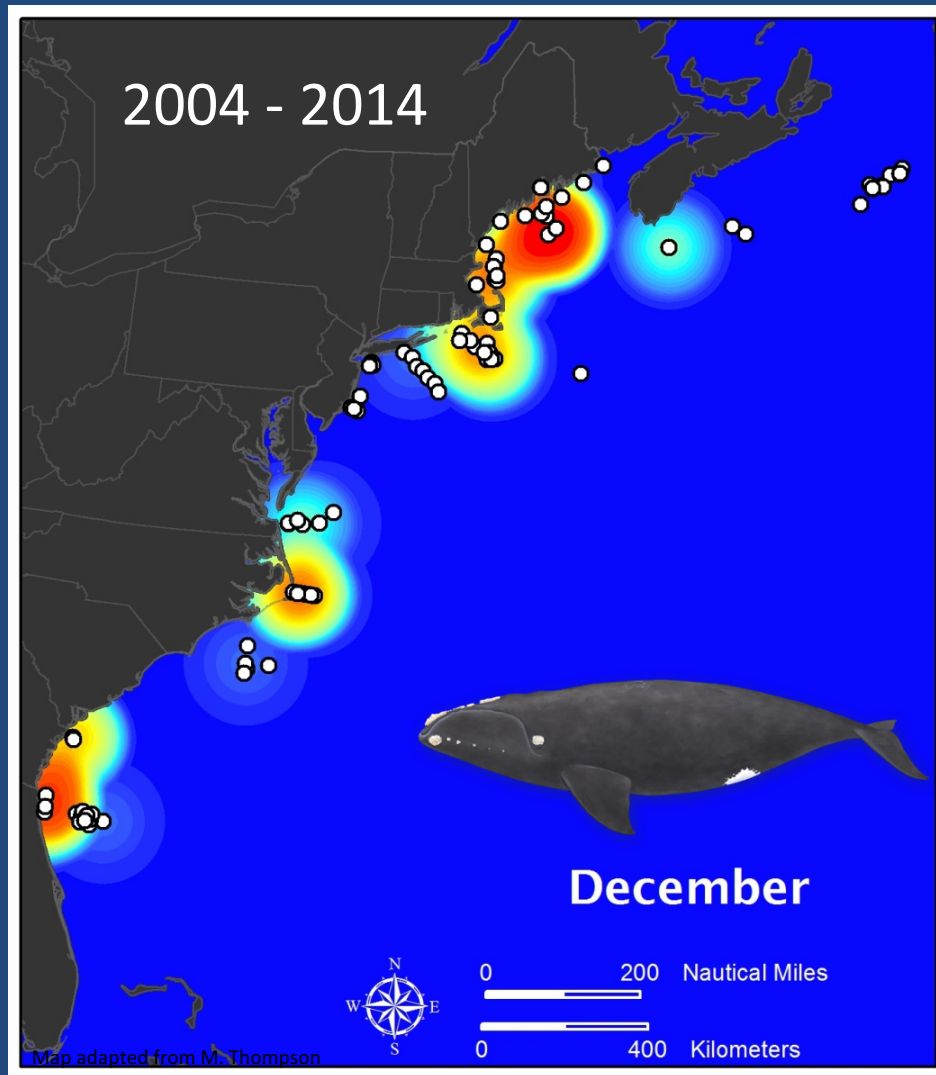


Figure: Mike Thompson, NOAA/SBNS

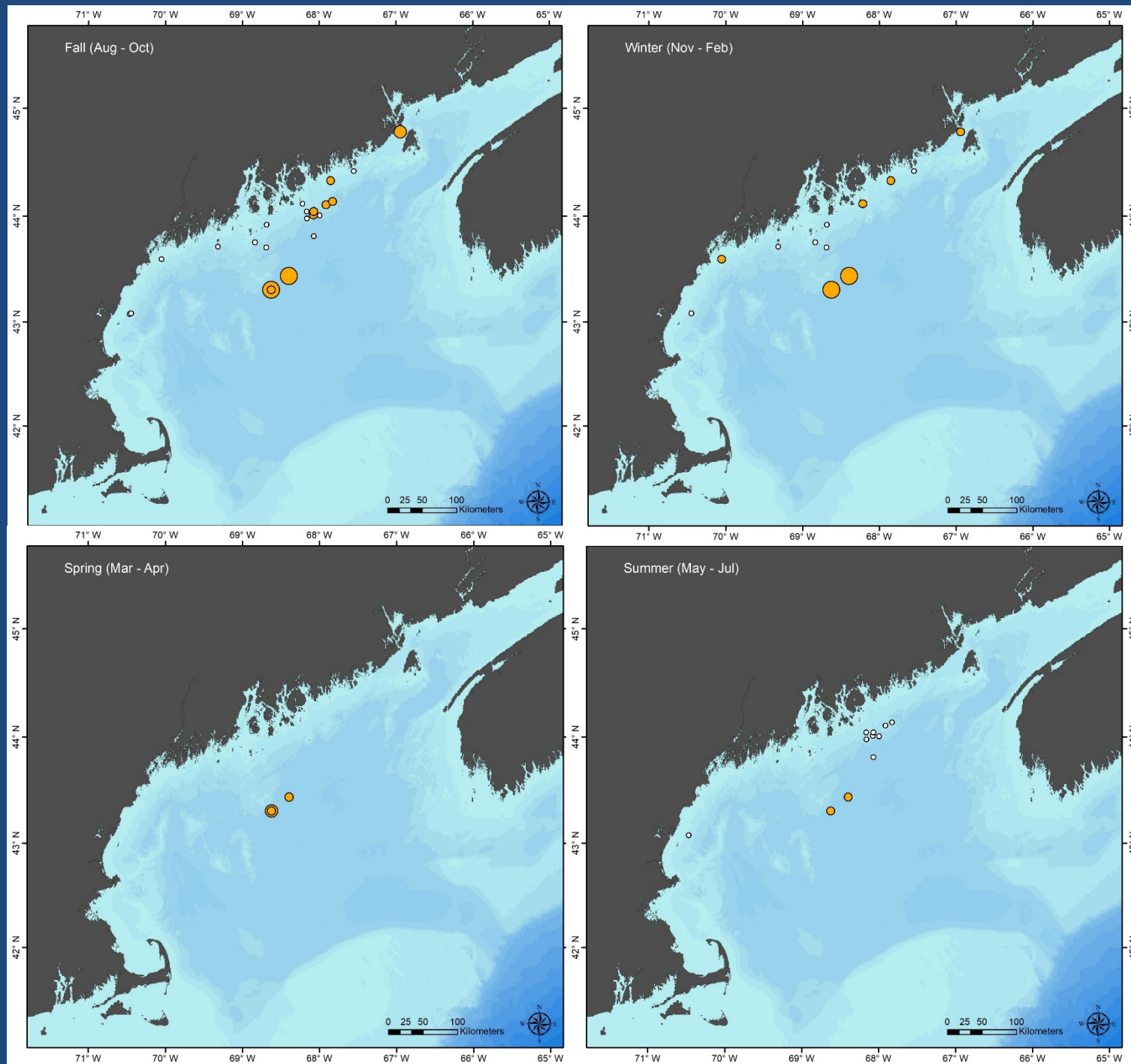
HISTORICAL PAM

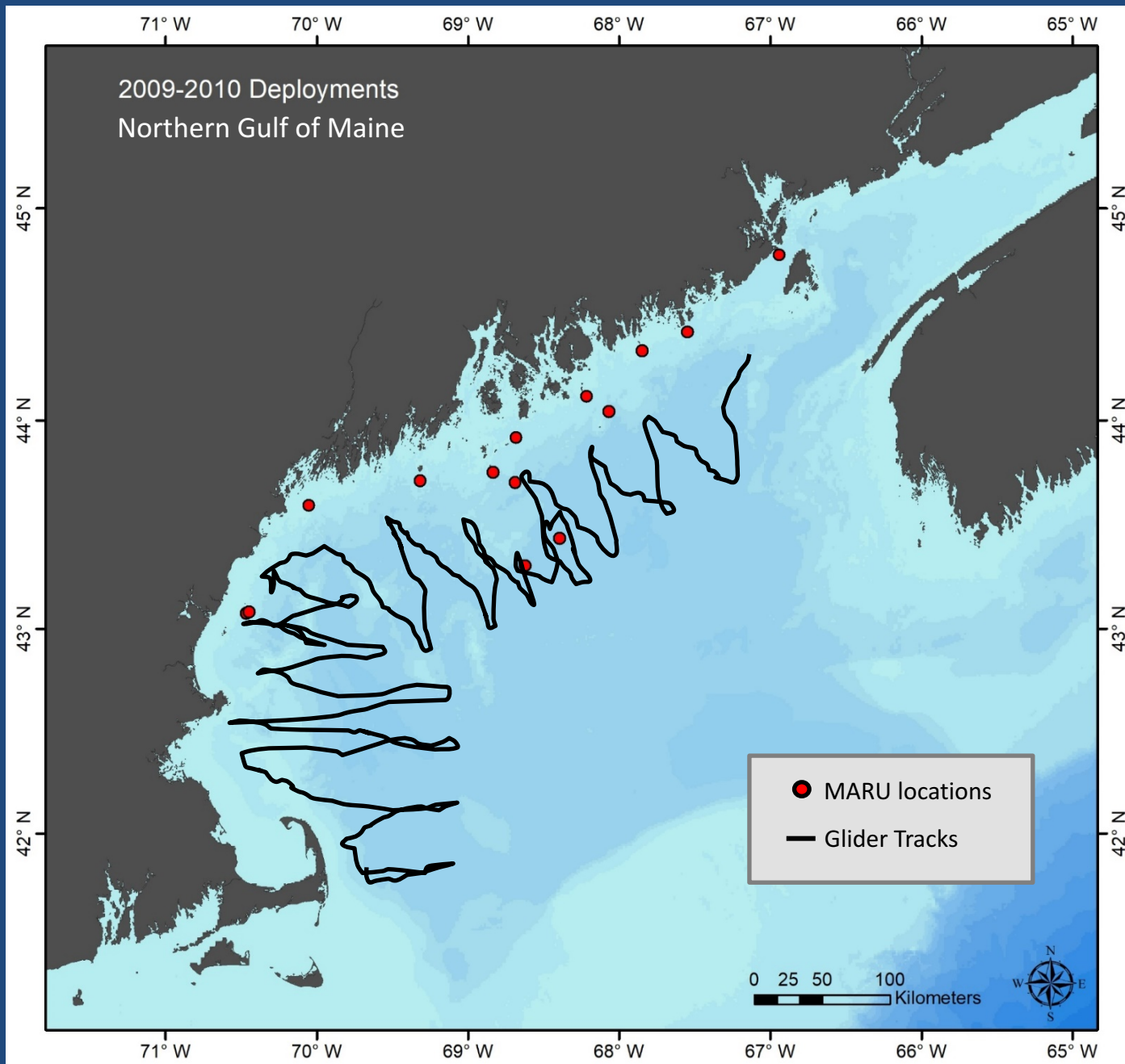


Davis et al. 2017. Long-term passive acoustic recordings track the changing distribution of North Atlantic right whales. Scientific Reports 7: 13460.

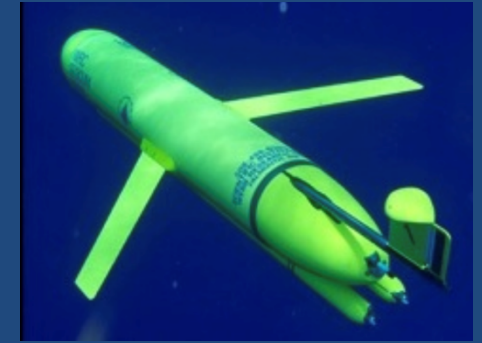
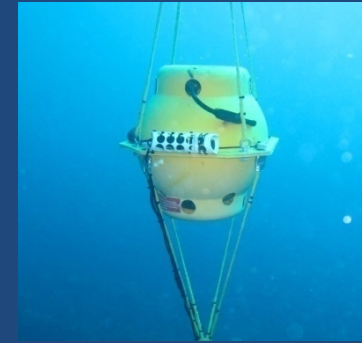
PREVIOUS ANALYSIS

- 2008 – 2011
- Only available archival PAM data from 2004-2019 in Northern GOM
- 3-6 month deployments
- NARW daily presence: verified LFDCS upcall detections
 - 30% missed detection rate (Davis et al. 2017)





CLOSER LOOK

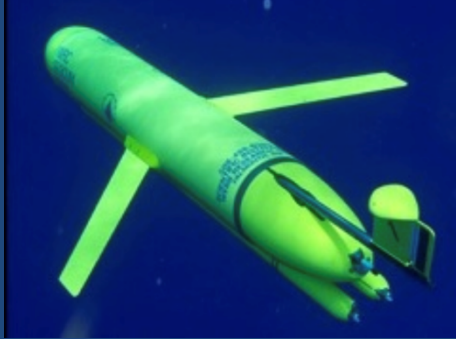
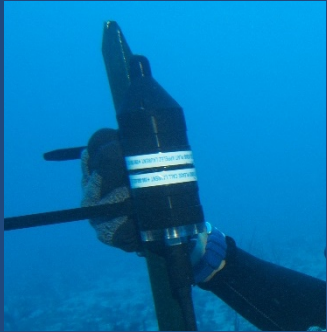
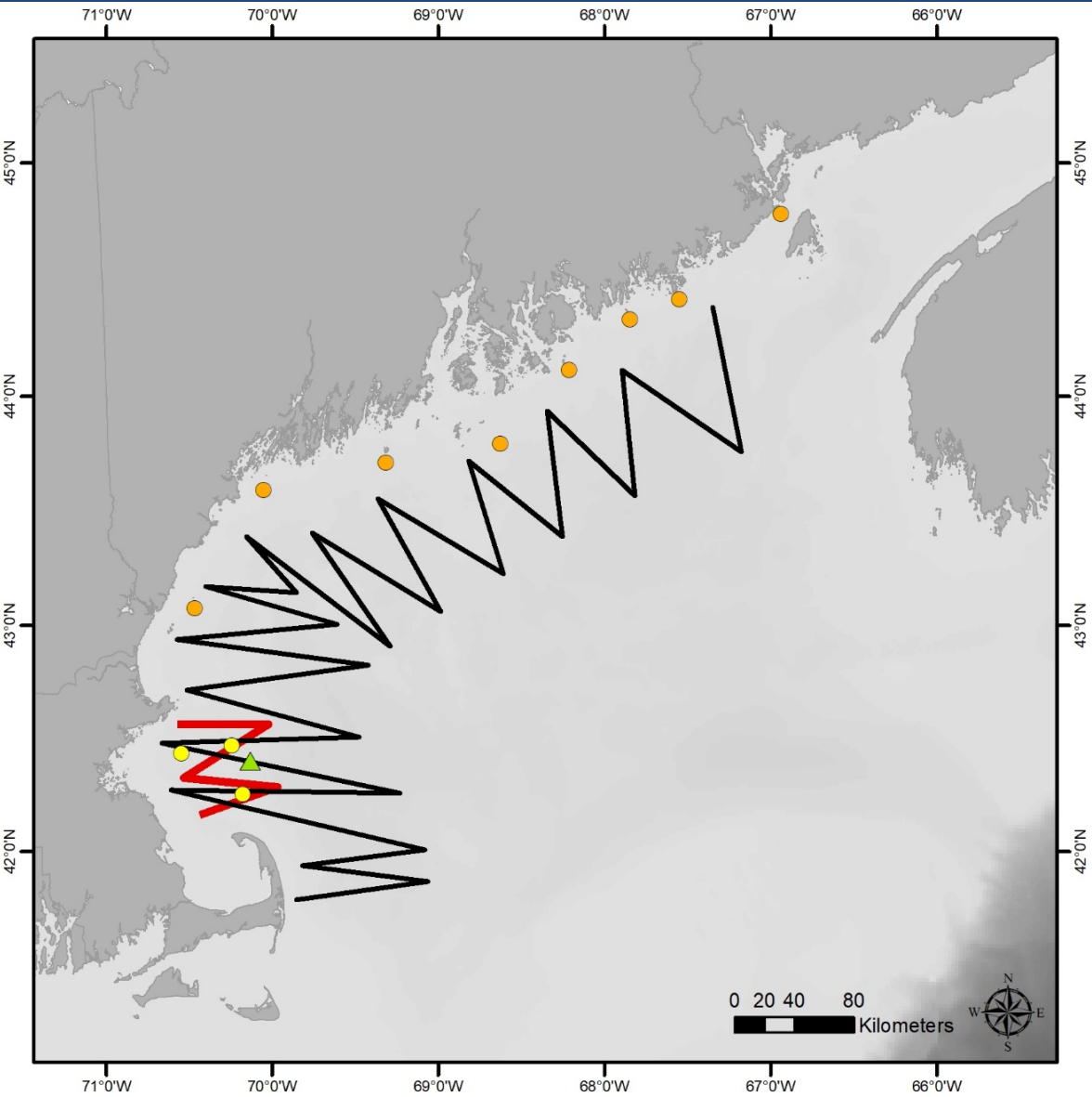


- 14 MARUs deployed between 2009-2010 (MEDMR & COA)
- Real-time glider deployed in winter 2018-2019 (WHOI)

Next steps:

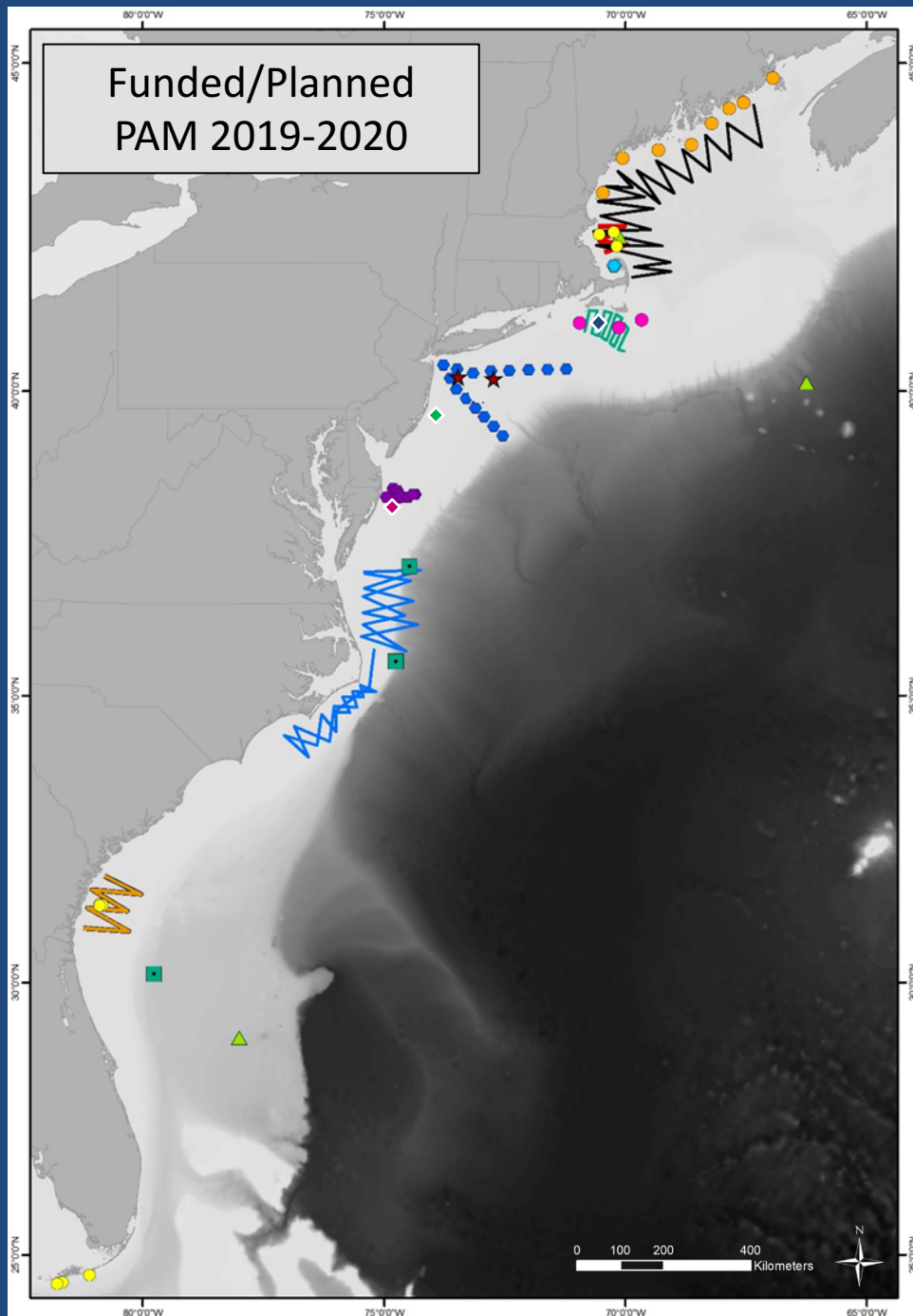
- Manually browse through all data
- Log all NARW call types

PLANNED PAM IN GOM



- 8 SoundTraps along inshore Maine starting ~January 2020
- Continuous monitoring for 1 year
- Real-time glider covering further offshore GOM

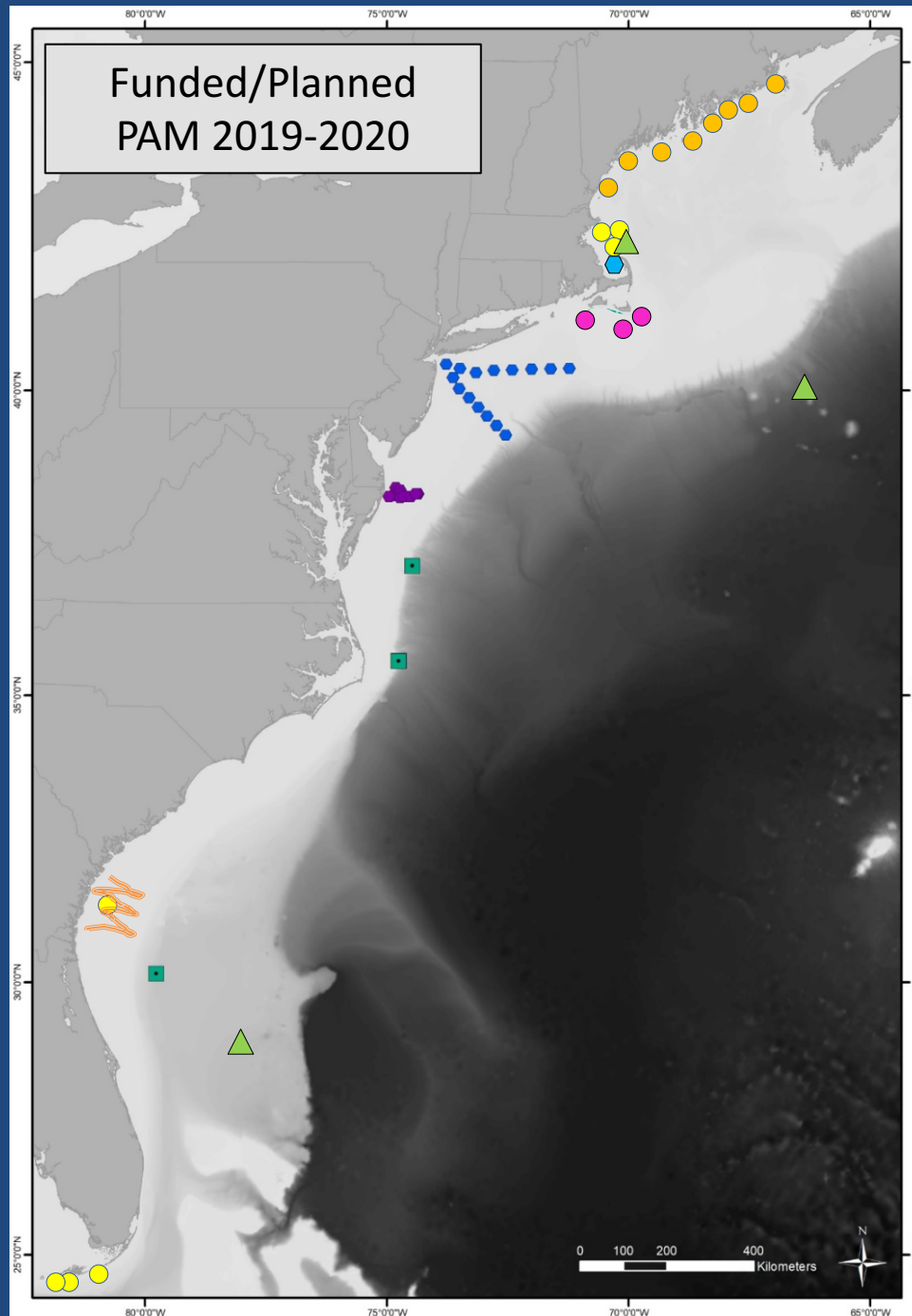
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Bottom Mounted		
● NEFSC/MEDMR	begins Jan '20	NMFS
● NEFSC/NOS	ongoing	Navy
▲ NEFSC/PMEL	ongoing	NOAA, NPS
Gliders		
— NEFSC/WHOI	Dec '19-Apr '20	NERACOOS
— NEFSC/NOS/WHOI	Jan-Apr '20	Navy



ARCHIVAL & REAL-TIME

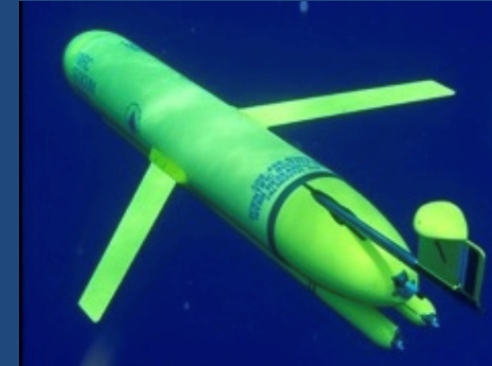
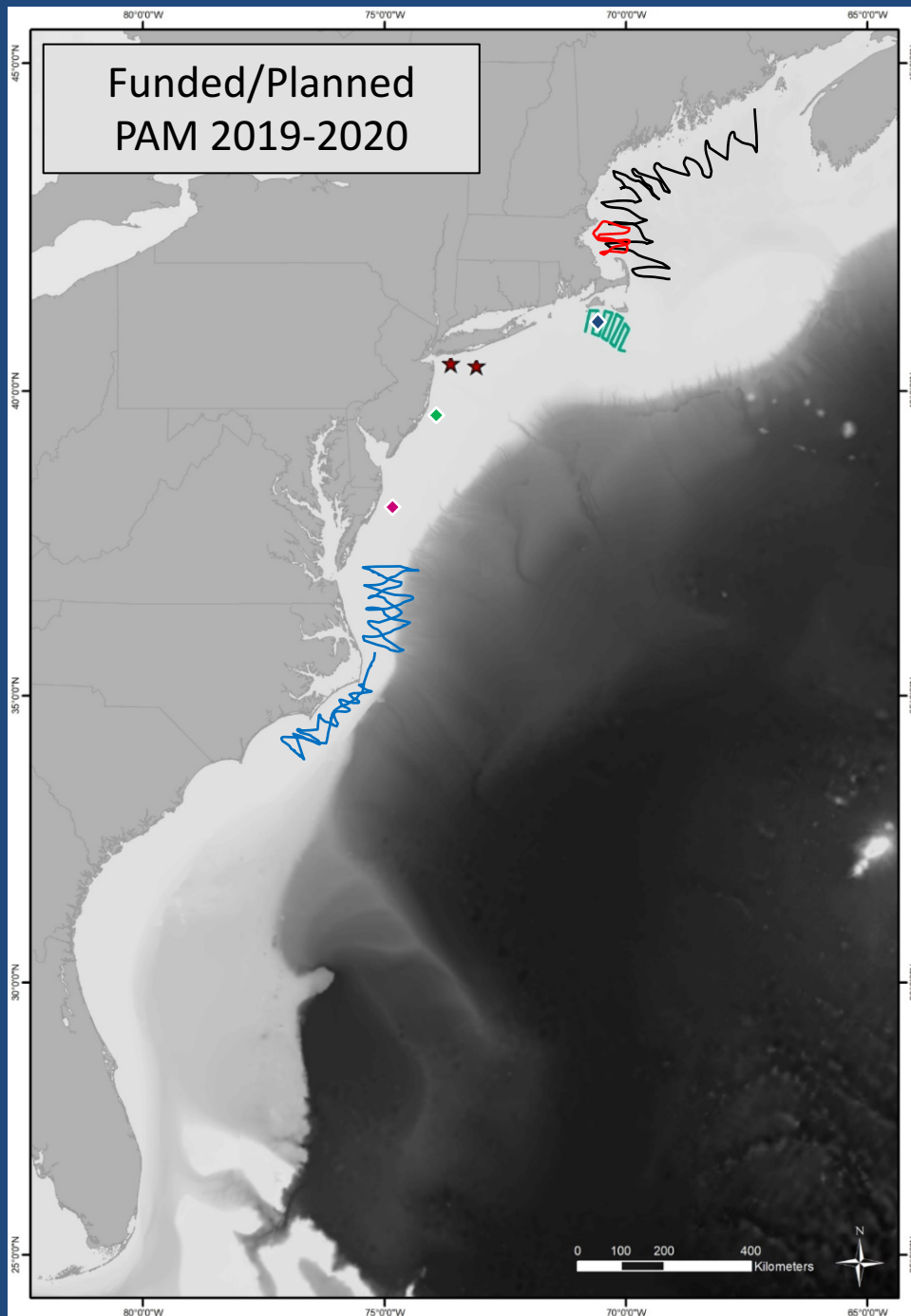
<u>Project POC</u>	<u>Timing</u>	<u>Funders</u>
Bottom Mounted		
● NEFSC	begins Dec '19	BOEM
● NEFSC/MEDMR	begins Dec '19	NMFS
● NEFSC/NOS	ongoing	Navy
▲ NEFSC/PMEL	ongoing	NOAA, NPS
★ WHOI/WCS Real-Time	ongoing	WCS
● BRP	ongoing	
● DEC/BRP	ongoing	NYDEC
● UMD/BRP	ongoing	BOEM
■ NAVFAC	ongoing	Navy
◆ UMD/WHOI Real-Time	May '20 - May '21	
◆ WHOI Real-Time	Mar '20 - Mar '21	
◆ WHOI Real-Time	Mar '20 - Mar '21	
Gliders		
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— NEFSC/NOS/WHOI	Jan-Apr '20	Navy
— NEFSC/WHOI	Dec '19-Apr '20	BOEM
— WHOI	Jan-Mar '20	NAVFAC
— NEFSC/NOS/Skidway U.	Oct-Dec '19, Mar-May '20	Navy

ARCHIVAL PAM 2019-2020



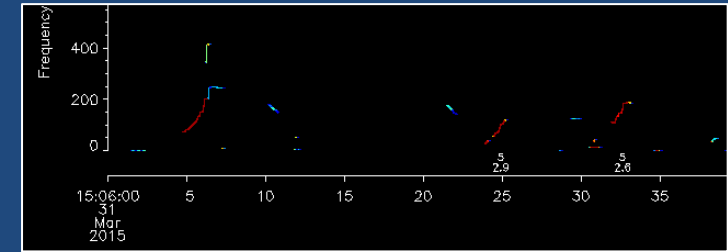
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Bottom Mounted		
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■ NAVFAC	ongoing	Navy
Gliders		
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REAL-TIME PAM 2019-2020



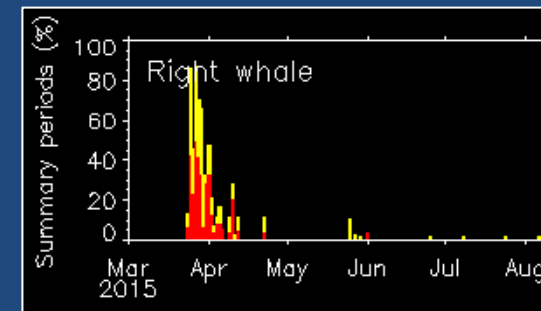
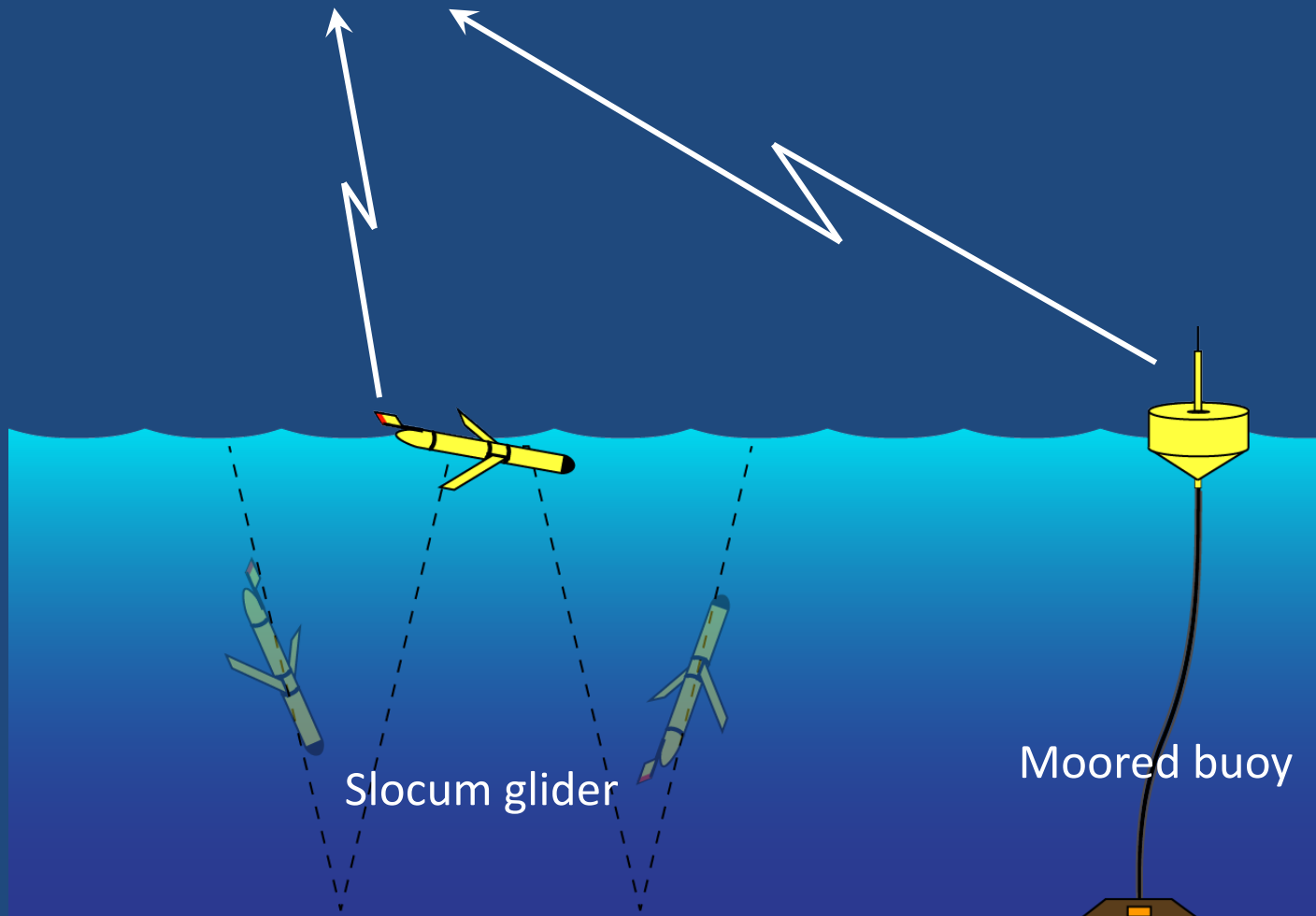
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— WHOI	Jan-Mar '20	NAVFAC

REAL-TIME MONITORING & MITIGATION



Analyst reviews:

- Pitch tracks
- Classifications
- Context



- Detected
- Possibly detected

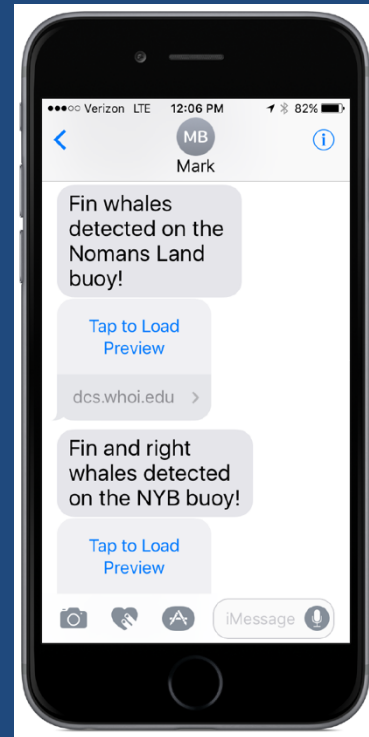
Date	Right whale
04/01/2015	Detected
03/31/2015	Detected
03/30/2015	Detected
03/29/2015	Detected
03/28/2015	Detected

REAL-TIME: DISTRIBUTION OF INFORMATION

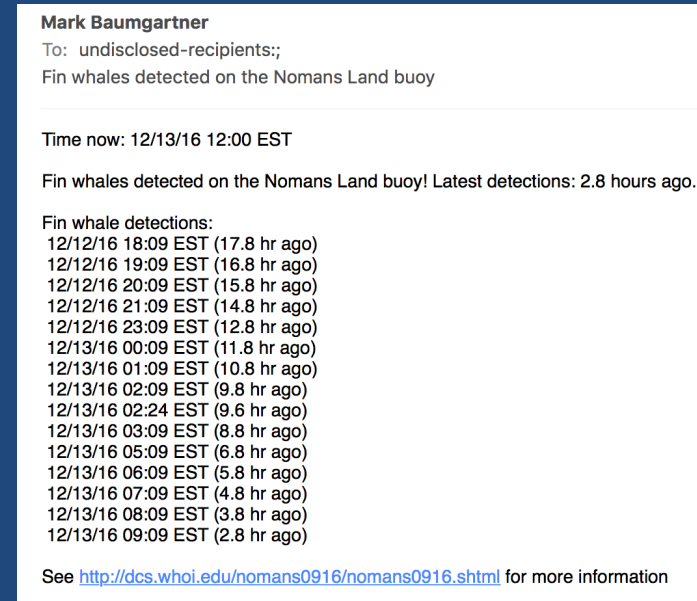
Daily analyst review:

Date	Sei whale	Fin whale	Right whale	Humpback whale
09/04/2015	Red	Red	Red	Grey
09/03/2015	Yellow	Red	Red	Grey
09/02/2015	Yellow	Red	Red	Grey
09/01/2015	Red	Red	Yellow	Grey
08/31/2015	Yellow	Red	Red	Grey
08/30/2015	Yellow	Red	Red	Grey
08/29/2015	Red	Red	Red	Red
08/28/2015	Red	Red	Red	Red

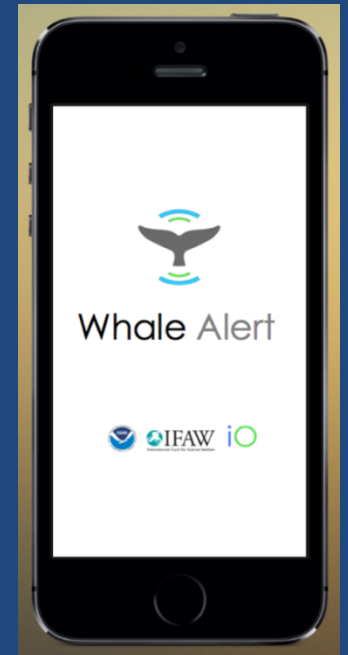
robots4whales.who.edu



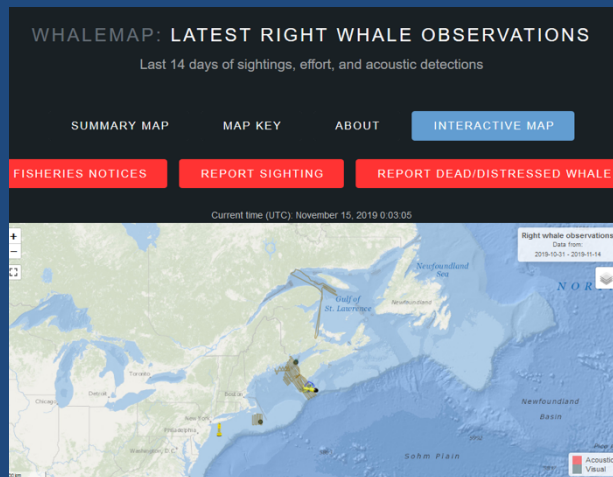
Text message



Email message

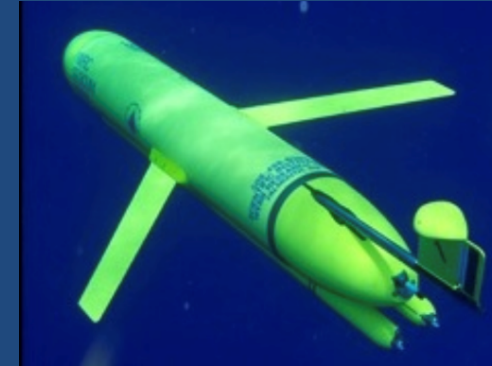
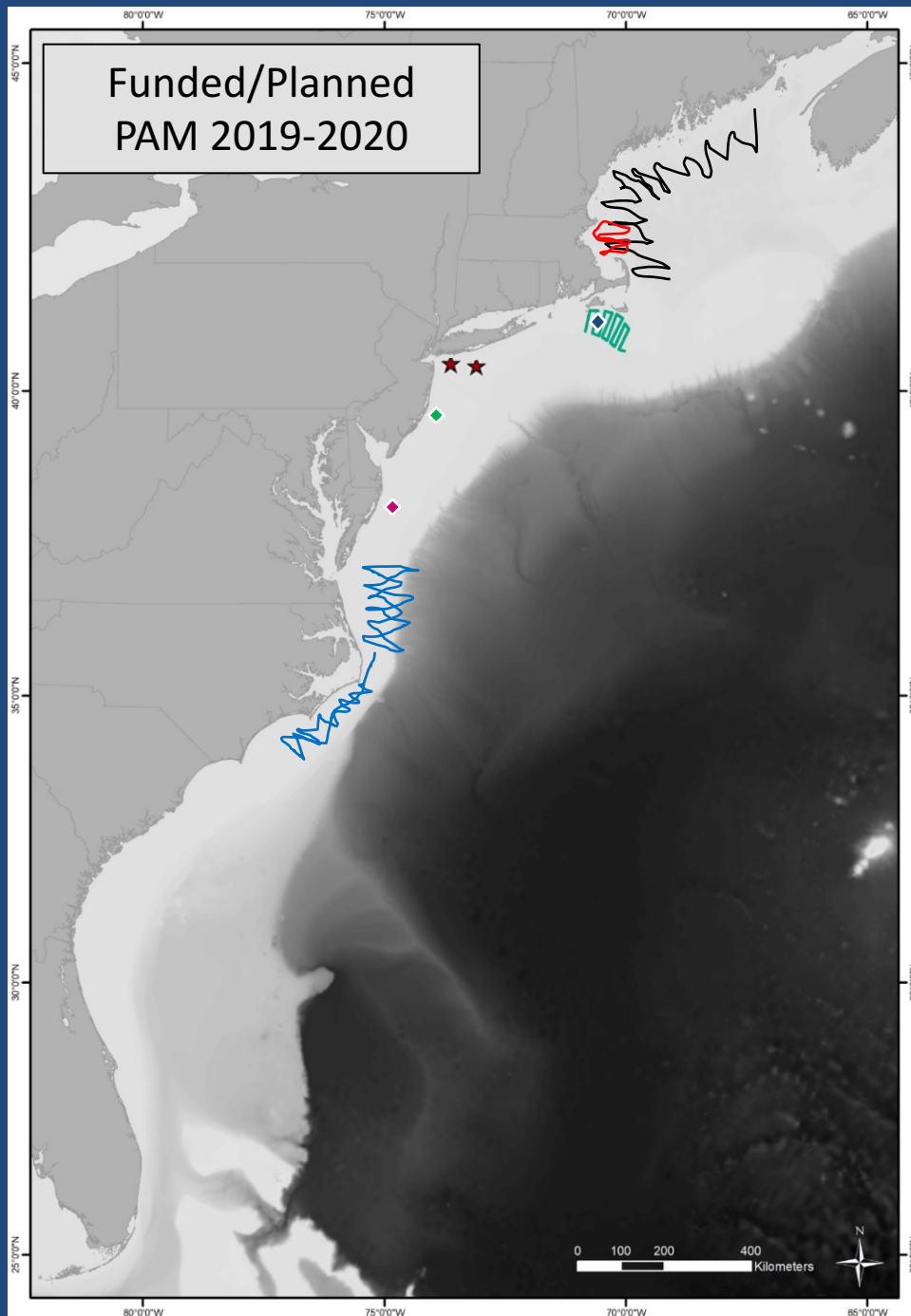


Whale Alert app



WHALEMAP
(DFO/Dalhousie)

REAL-TIME PAM 2019-2020



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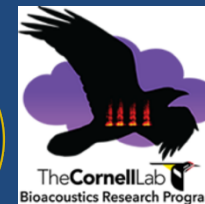
- College of the Atlantic
- Center for Conservation Bioacoustics, Cornell University
- Chris Tremblay
- Samara Haver
- Mass Division of Marine Fisheries
- Jenni Stanley, Tim Rowell, & the passive acoustics research group, NOAA NEFSC
- Ocean Instruments
- NAVFAC

- Field and cruise teams

- Funding & support from:



Fisheries and Oceans
Canada



Thank you!